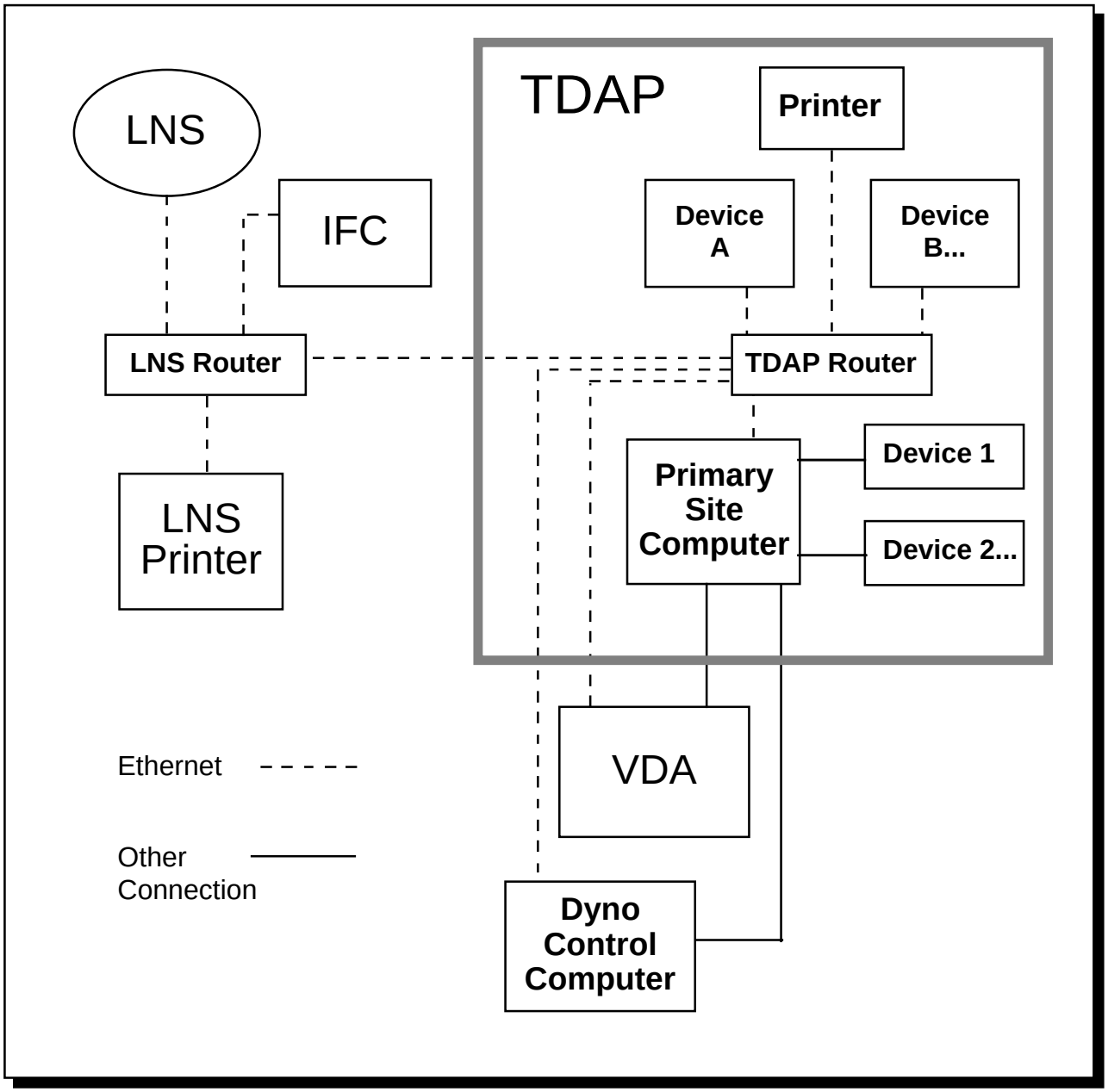
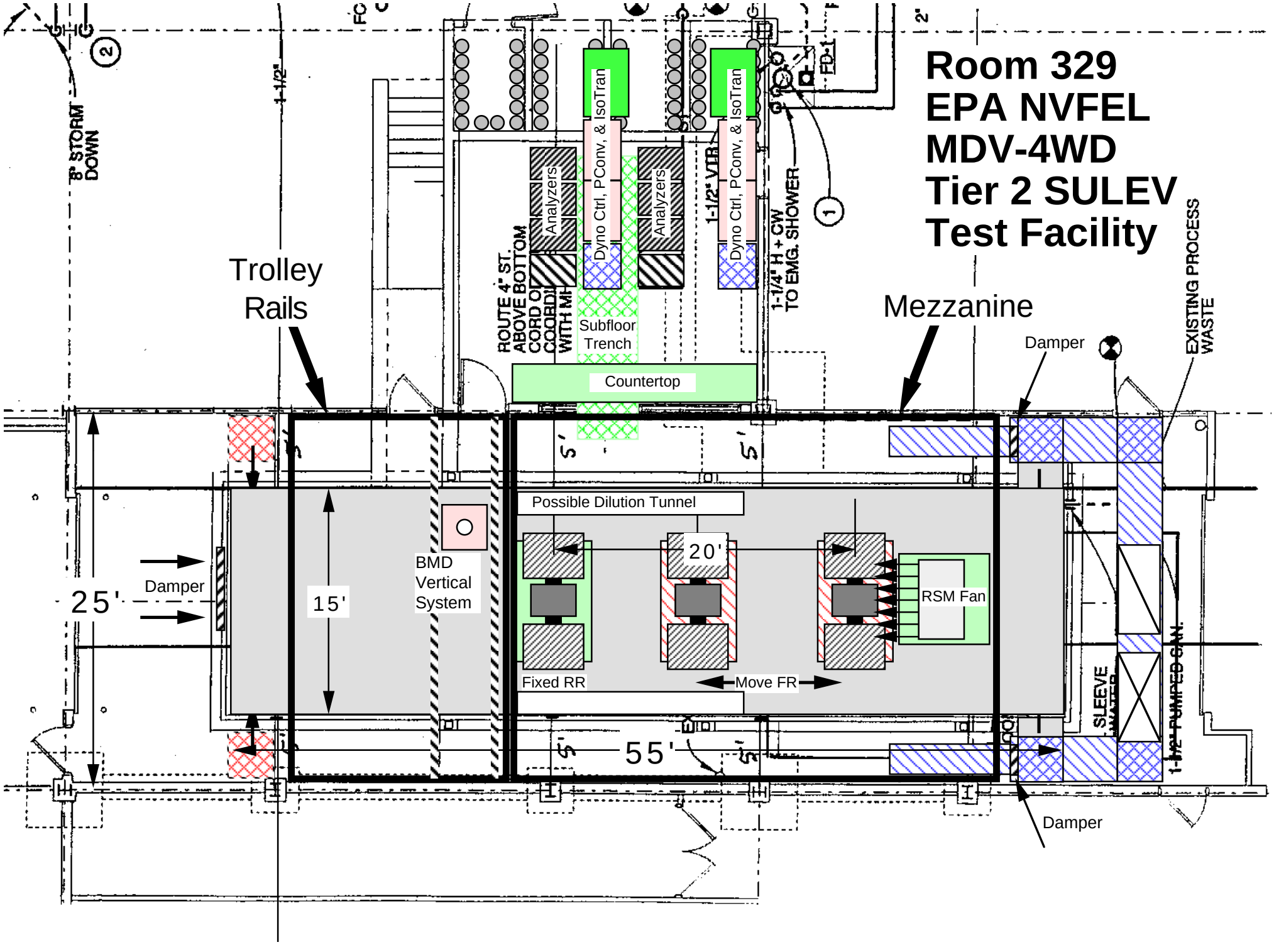
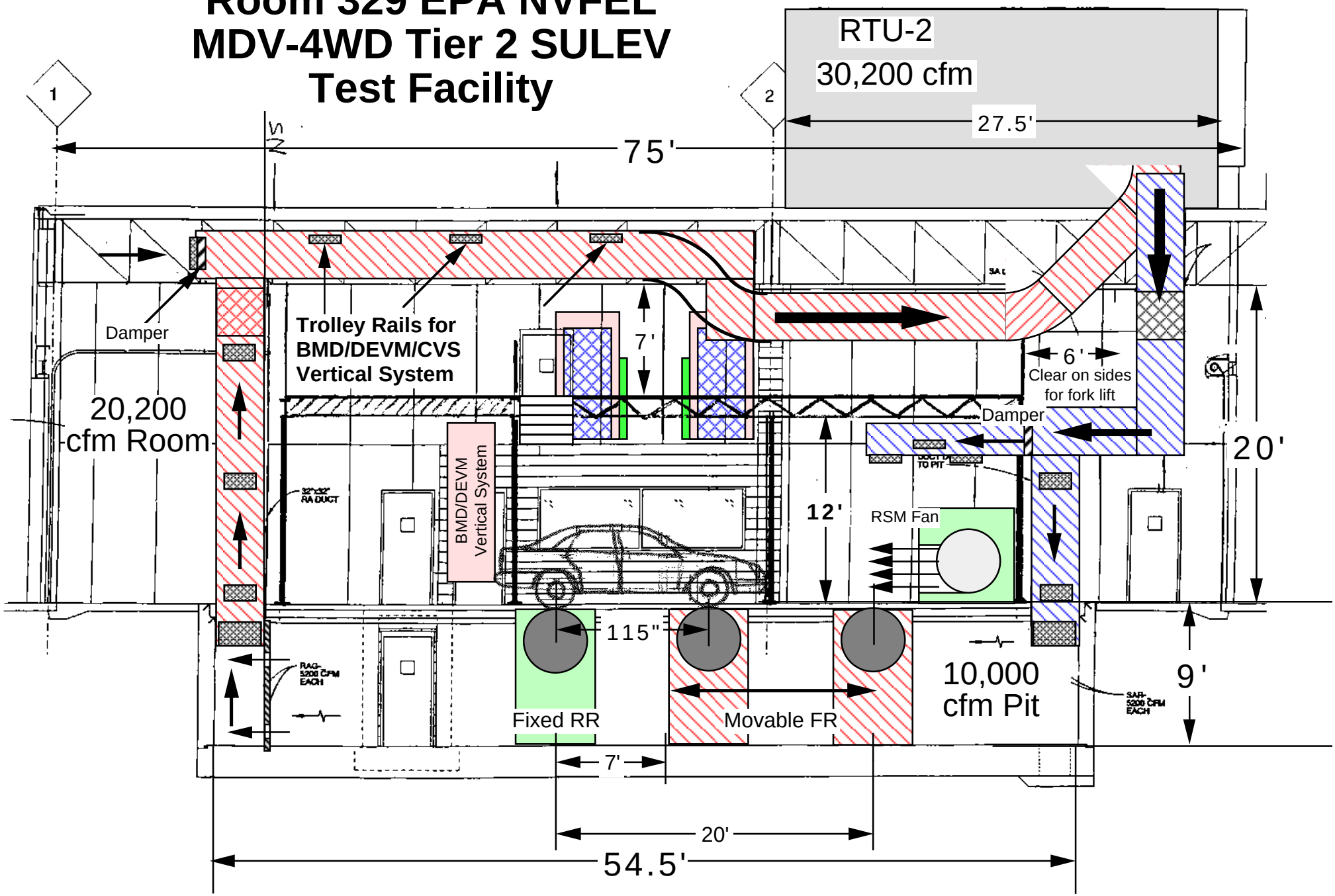
Figure 1. Measurement System Architecture

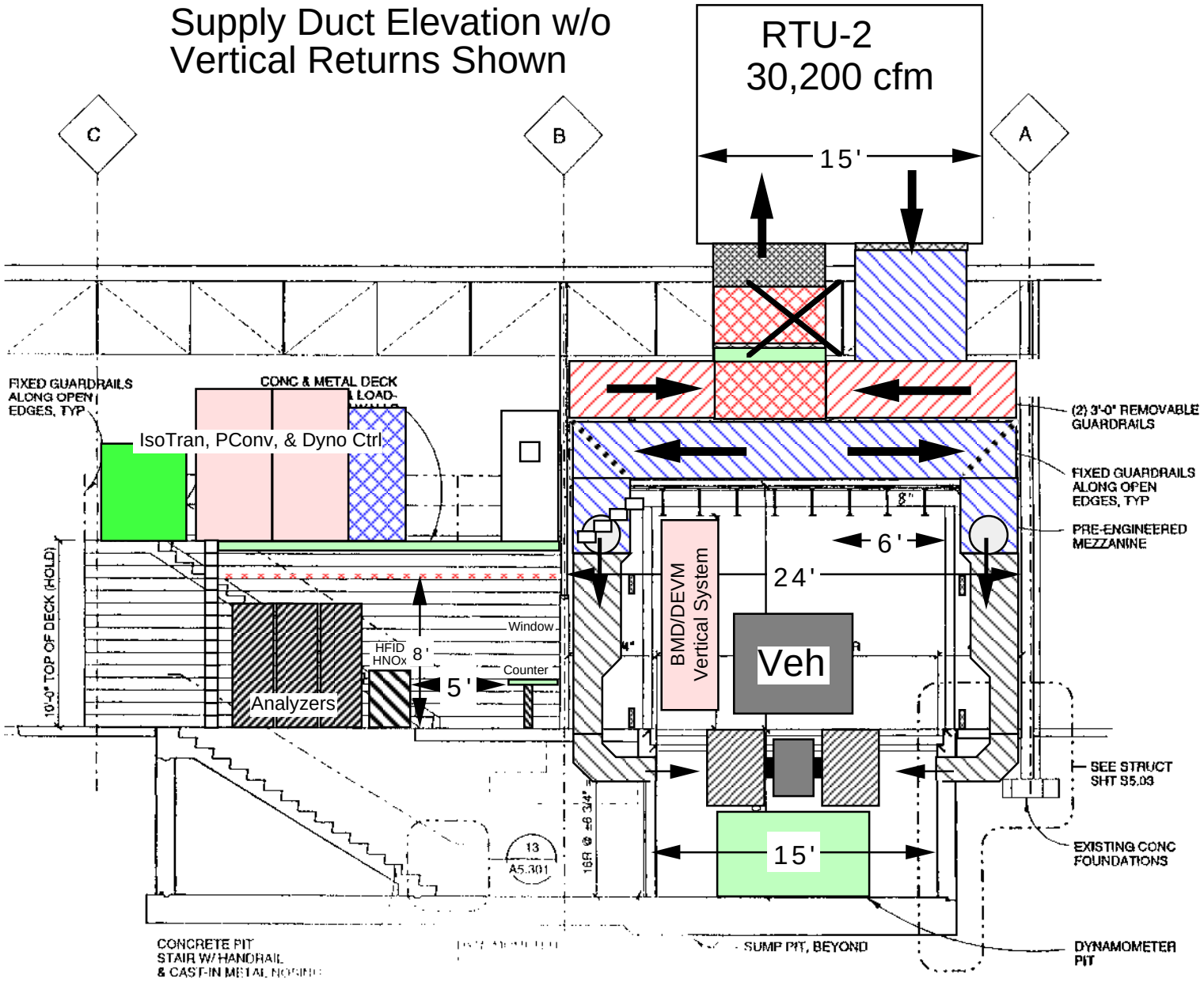



Room 329
EPA NVFEL
MDV-4WD
Tier 2 SULEV
Test Facility
Trolley
Rails
Mezzanine
Damper
EXISTING PROCESS
WASTE
Analyzers
Dyno Ctrl, PConv, & IsoTran
Analyzers
Dyno Ctrl, PConv, & IsoTran
Subfloor
Trench
Countertop
Possible Dilution Tunnel
BMD
Vertical
System
20'
RSM Fan
25'
Damper
15'
Fixed RR
Move FR
55'
Damper
SLEEVE

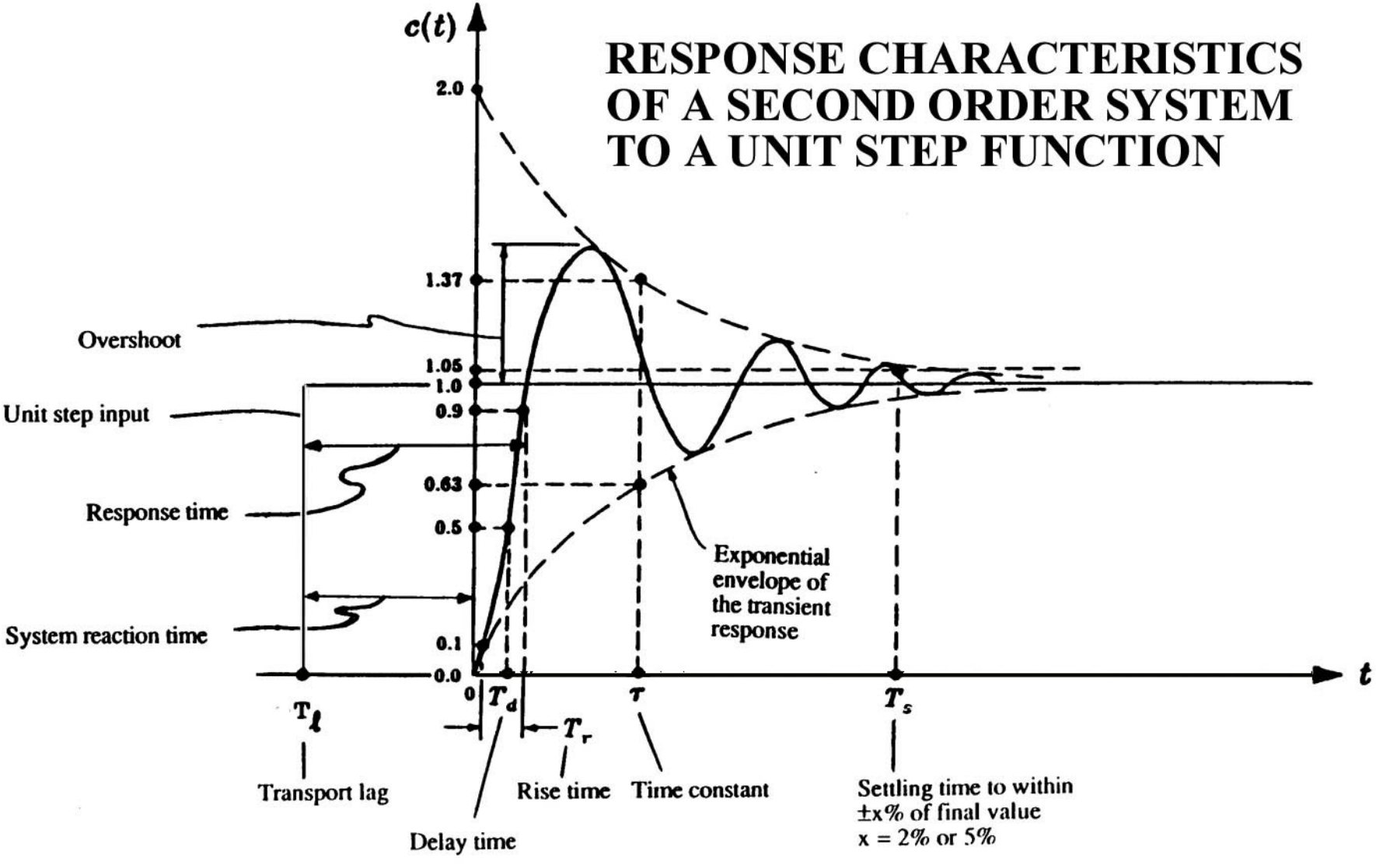
Room 329 EPA NVFEL MDV-4WD Tier 2 SULEV Test Facility



Supply Duct Elevation w/o Vertical Returns Shown



RESPONSE CHARACTERISTICS OF A SECOND ORDER SYSTEM TO A UNIT STEP FUNCTION



Glossary of Response Criteria Terminology

Overshoot	The overshoot is the maximum difference between the transient and steady state output of a system in response to a unit step input. Overshoot is a measure of relative stability and is often represented as a percentage of the final value of the steady state output.
Percent Overshoot	$= [(M_{pt} - c_{ss}) / c_{ss}] *100\%$ where: M_{pt} = peak value c_{ss} = steady state or final value of c(t)
Delay Time (T_d)	The time delay is defined as the time required for the response to a unit step function to reach 50 percent of the final input value.
Rise Time (T_r)	The rise time is customarily defined as the time required for the response to a unit-step function input to rise from 10 to 90 percent of the final value.
Settling Time (T_s)	The settling time is defined as the time required for the response to a unit-step function input to reach and remain within a specified percentage (frequently 2 to 5 percent) of its final value.
Time Constant (t)	The predominant time constant is an alternative measure of settling time. The envelope of the transient response decays to 37 percent of its initial value in (t) seconds.
Transport Lag (T_l)	The transport lag is the delay in the onset of a change in feedback as a response to a change in system output.
Reaction Time	The system reaction time is defined as the minimum time lag between an input change and the resultant change in system output and is the direct summation of the unrelated, forward transport lags in the system. Reaction time is sometimes incorrectly referred to as Response Time.
Response Time	The response time is defined as the lag between an input change and the time the response rises to 90 percent of the final value.

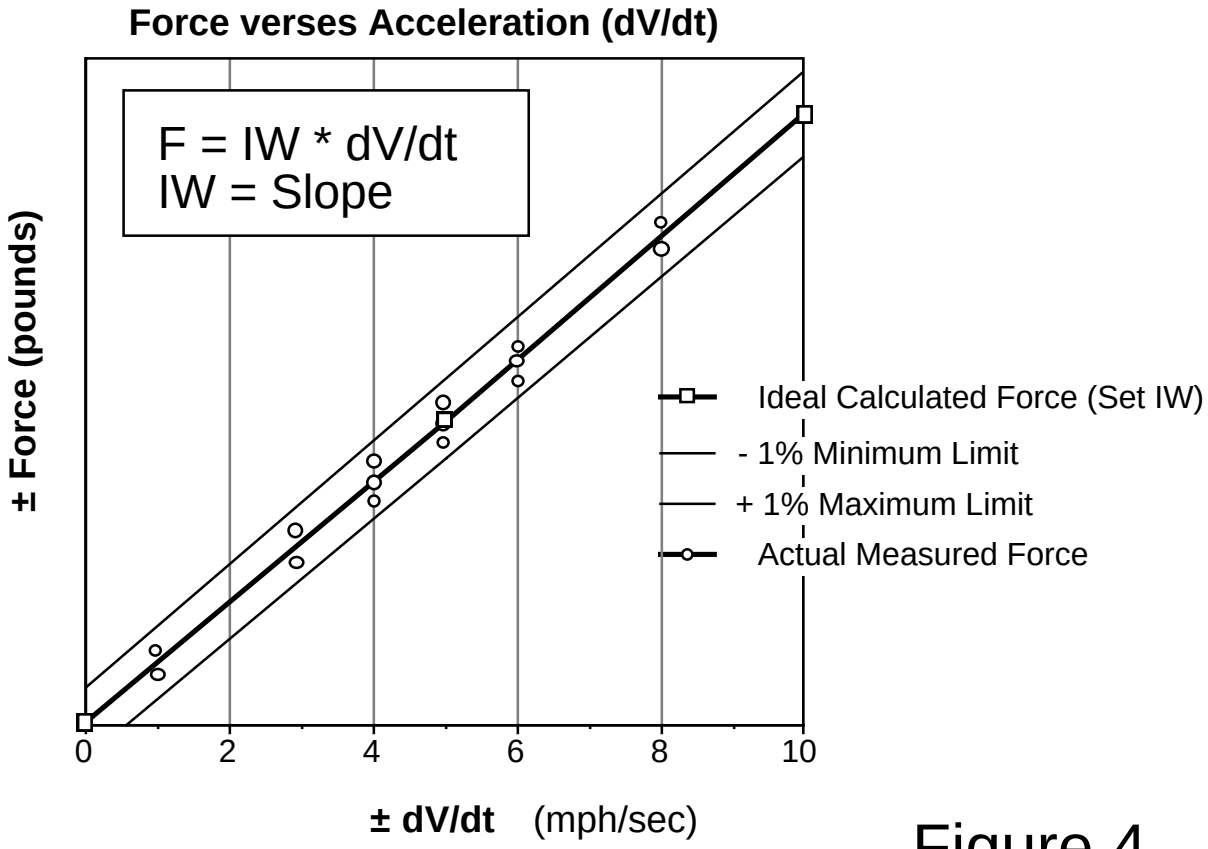
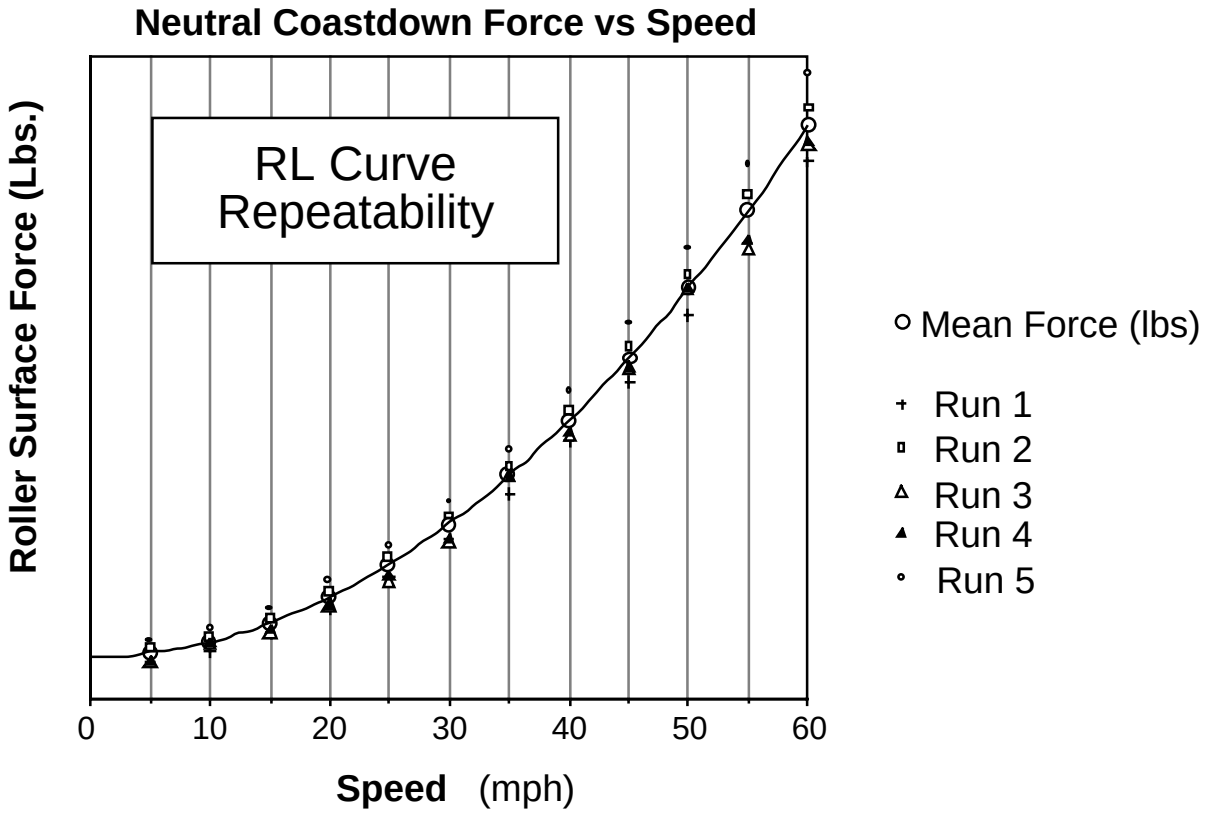

Force verses Acceleration (dV/dt)
F = IW * dV/dt
IW = Slope
± Force (pounds)
0
2
4
6
8
10
± dV/dt (mph/sec)
Ideal Calculated Force (Set IW)
- 1% Minimum Limit
+ 1% Maximum Limit
Actual Measured Force

Figure 4


Neutral Coastdown Force vs Speed
RL Curve
Repeatability
Roller Surface Force (Lbs.)
0
10
20
30
40
50
60
Speed (mph)
Mean Force (lbs)
Run 1
Run 2
Run 3
Run 4
Run 5

Dynamometer Response Rise and Settling Time Illustration

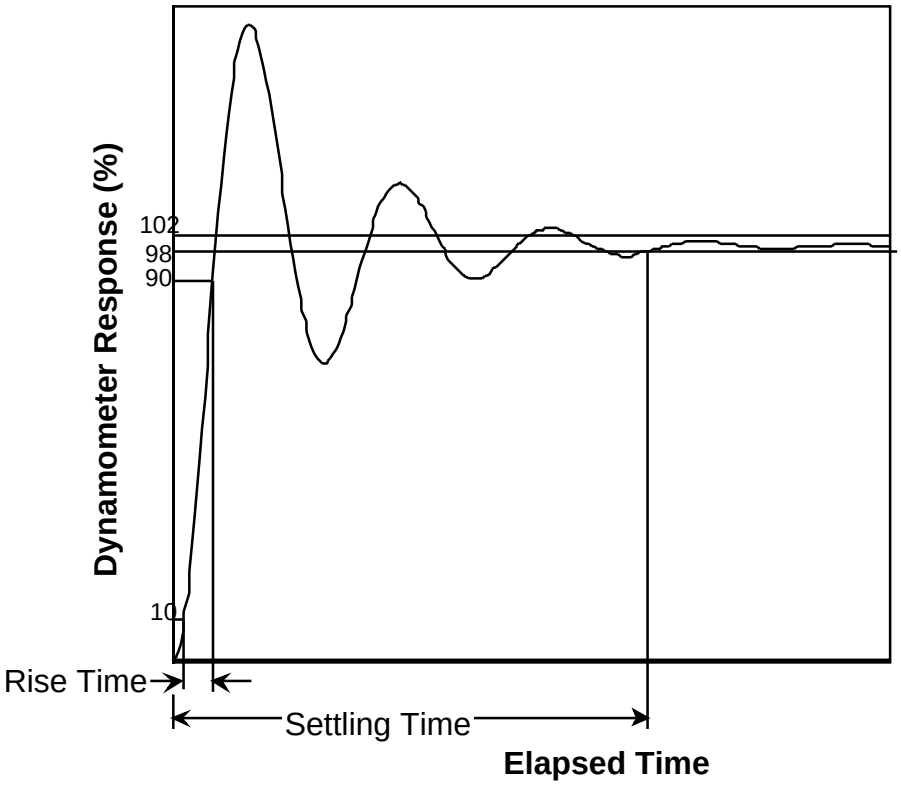
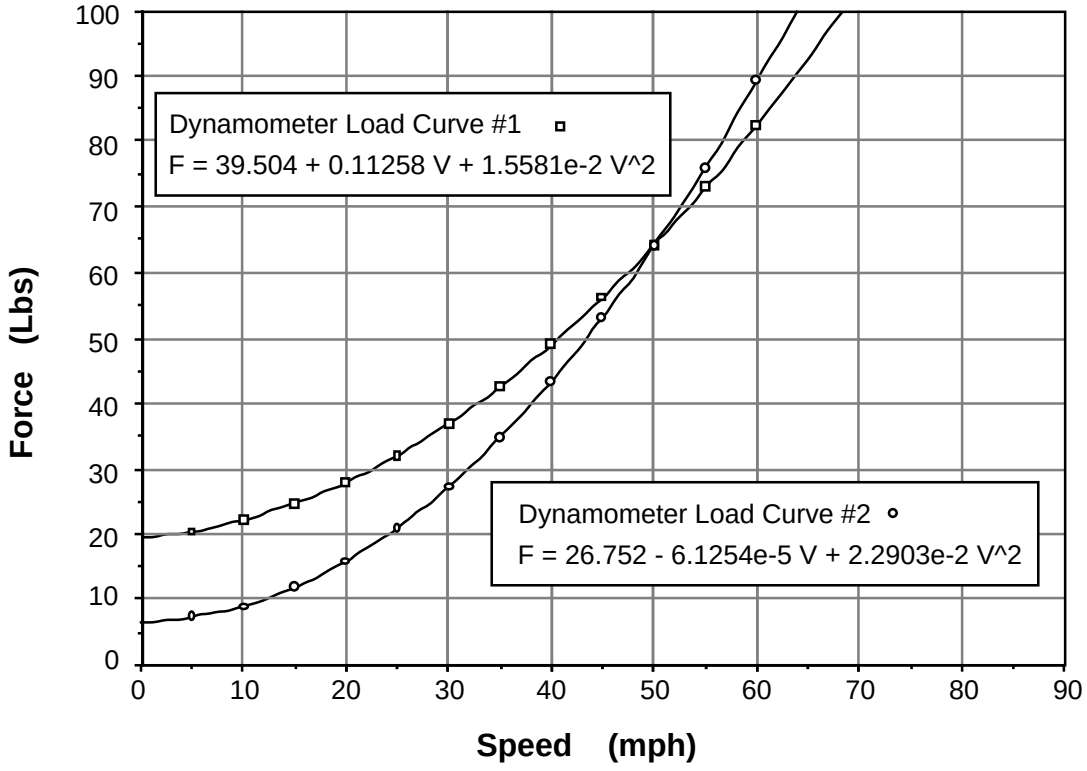


Figure 5

Steady State Dynamometer Load Curves



Symbols and Specification Terminology

SYMBOLS			UNITS
A	Constant rolling resistance parameter		N, lb
a	Constant friction characteristic		N, lb
B	Speed proportional rolling resistance parameter		N/kph, lb/mph
b	Speed proportional friction characteristic		N/kph, lb/mph
C	Speed squared (wind) resistance parameter		$N/(kph)^2$, $lb/(mph)^2$
c	Speed squared friction characteristic		$N/(kph)^2$, $lb/(mph)^2$
D	Parameter for braking and miscellaneous forces		dimensionless
F	Thrust parallel to road or tangential to roll		N, lb
FE	Force Error		N, lb
FEF	Force error fraction		dimensionless
g	Gravitational acceleration	9.807 m/sec^2 or 35.304 kph/sec 32.174 ft/sec^2 or 21.937 mph/sec	
M	Effective mass	4.448 N/lb	N, lb
n	Number of data points		
P	Power transmitted through roll surface	1.341 Hp/kW	kW, hp
r^2	Regression coefficient		dimensionless
S	Distance roll surface moved since distance counter reset		m, ft
sin θ	Sine of hill angle above (+) or below (-) horizontal		dimensionless
t	Time		sec
dt	Derivative of time		sec
Dt	Finite time interval		sec
V	Speed over road or roll surface		kph, mph
VE	Speed error		kph, mph
dV	Derivative of speed		kph, mph
DV	Finite change of speed		kph, mph
W	Gross weight of vehicle including passengers		N, lb
ω	Angular velocity		rads/sec
dV/dt	Linear acceleration		m/sec^2, ft/sec^2
dω/dt	Angular acceleration		$rads/sec^2$

Subscripts

a	Average
c	Calculated
d	Device which provides load in a complex chassis roll system
g	Correction for gravitational and engineering units: Multiplied by 35.304 kph/sec in SI OR Multiplied by 21.937 mph/sec in Imperial system
i	Inside control loop
m	Measured
o	Outside control loop
R	Road equivalent
1, 1-2, 2-3	From point 1, 1 to 2, 2 to 3, etc.